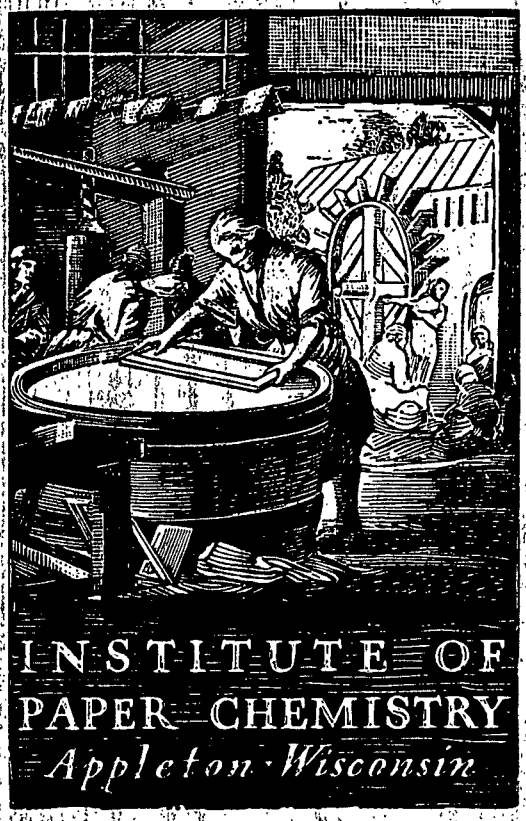

CONFIDENTIAL

CONSUMPTION OF SELECTED PAPER INDUSTRY RAW MATERIALS.

IV. 1971 and 1972

Project 3066

July, 1973

THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

CONSUMPTION OF SELECTED PAPER INDUSTRY RAW MATERIALS. IV. 1971 and 1972

Project 3066

July, 1973

TABLE OF CONTENTS

THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

CONSUMPTION OF SELECTED PAPER INDUSTRY RAW MATERIALS. IV. 1971 and 1972

SUMMARY

The fourth confidential survey of selected raw materials consumed by U.S. basic pulp and paper manufacturers covered the years 1971 and 1972. This report summarizes reported and estimated consumption of white pigments and minerals; latexes for pigment binding, coating and saturating; papermaking additives, including agents for sizing, wet-strength, dry-strength and formation, and for improving retention, drainage and flocculation; and a group of 26 additional chemicals used in various pulping, bleaching, sizing, and coating applications. Estimated expenditures for dyes and colored pigments are also indicated.

The reports received by the Institute represented 670 U.S. mills whose combined production capacity amounted to about 95-96% of the total U.S. pulp and paper capacity. Estimates have been included for most of the mills which did not respond; the exceptions are noted in the report.

A summary of consumption data provided by a group of 19 independent converters is also presented.

INTRODUCTION

The 1971-72 survey was the fourth in a series of confidential industry-wide studies conducted by the Chemical Resources Group at The Institute of Paper Chemistry. Previous reports dealt with (a) 1963-1964 consumption of starches, pigment binders, and latexes; (b) 1966-1967 usage of white pigments and minerals, pigmented coating additives, and a group of miscellaneous chemicals; (c) 1969-1970 consumption of 50 grades of paper stock, including end use in 17 grades of paper and paperboard (see Tappi, November, 1972, Volume 55, no. 11, pages 1605-1608). The purpose of the surveys has been to assist research, development, production, and sales planning groups in firms representing the paper industry, as well as its suppliers.

The questionnaire and list of trade names attached to this report were distributed by mail beginning in May, 1972. They were sent to all pulp and paper mills listed as operating in the 1971/72 edition of Lockwood's Directory of the Paper and Allied Trades, and also to 266 independent converters of paper and paperboard. Several follow-up mailings were made at intervals, and a number of replies were finally obtained by telephone.

The responses represented 670 U.S. mills whose combined daily production capacity amounted to 95-96% of the total U.S. capacity for pulp, paper, and paperboard as recorded in Lockwood's Directory. Of the mills that responded, 114 stated that they used none of the chemicals in the survey; their capacities amounted to only 4% of the U.S. total. Mills representing another 4% of U.S. capacity made no response whatever; it is probable that their use of the chemicals studied is a relatively small portion of the U.S. total.

Estimates were made for most of the missing respondents. To do so, the mills for which data were lacking were grouped into separate categories according to the type of paper or paperboard product manufactured. Lockwood daily capacity figures were then totaled for each class of nonparticipants, and also for a group of similar companies that had provided data. The ratios of these capacity totals were then used to calculate consumption for each class; in doing so, the estimates were occasionally modified to take into account any other pertinent information available, including data collected in previous surveys.

Questionnaires were also sent to a group of 266 independent converters, but only a small response resulted. The second mailing to converters was limited to the firms believed to be most likely to use chemicals. Of the total of 48 replies received, 29 companies reported that they consumed none of the materials being surveyed. In several instances these negative replies were inconsistent with the product lines and/or equipment descriptions given in Lockwood's Directory. It would appear that a more direct form of inquiry, for example by telephone, would be required to obtain a significant response from independent converters.

Although only 19 converters reported actual consumption of chemicals, the data received are summarized in each section of the report. It was impractical to attempt to provide estimates for the hundreds of converting plants that did not respond.

SURVEY CONCLUSIONS

SUMMARY OF GENERAL FACTORS INFLUENCING THE DATA

1. Replies were received from United States primary manufacturers of pulp, paper, paperboard, building papers, and wet machine board, representing 95-96% of the total daily capacities listed in the 1971/72 edition of Lockwood's Directory. The basic manufacturers were asked to include consumption data for chemicals used in their converting operations. A number of companies were unable to do so, because the information from their geographically scattered converting plants could not be collected readily, if at all. No estimates for the missing data of this nature can be provided.

2. No data or estimates are presented for several papermaking companies that are possibly important users of certain chemicals, but for which not enough information was available to permit making reasonable predictions of consumption. These firms included Armstrong Cork Co., Budd Co., Burgess Cellulose Co., Charmin Paper Products Co., Dexter Corp., Eastman Kodak Co., W. R. Grace & Co. converting divisions, Interstate Folding Box Co., Minnesota Mining & Manufacturing Co., NVF Co., and Pleasant Valley Paper Mills, Inc.

3. Data for 19 independent converters are reported separately. (Independent converters are companies that modify paper or paperboard as a part of their manufacturing operations, but do not produce paper or paperboard per se, and are not subsidiaries of paper or paperboard manufacturers.)

4. The tables record the number of replies which stated that a given chemical had been used in either 1971 or 1972. These numbers are not equivalent to the total number of mills that used the material, since 22 reports contained

consolidated information for a total of 142 individual mills. Also the numbers do not include the mills for which tonnages had to be estimated.

5. Central purchasing departments of several major companies submitted reports that represented a number of mills. A few of these centrallized sources have commented that information available at corporate headquarters may not include some purchases made at individual mills. For the most part these omissions are probably of items that constitute relatively small expenditures.

6. In considering the indicated rates of growth or decline in chemical consumption, it should be recognized that many companies estimated 1972 consumption at approximately the middle of that year. Unsettled business conditions made this a difficult task. Other mills delayed making their reports until 1973, at which time substantial numbers of them could no longer provide exact information for 1971. Although these two factors may tend to counterbalance each other, the indicated rates of change are not as meaningful as would be desired. If companies supplied information for only one year, it was assumed that consumption was at the same level during the other year also, unless qualifying information was available.

7. Respondents may have a tendency to overlook consumption of chemicals that are not actually named on a questionnaire, even if suggestions are included in a guide list; hence, both the tonnages and varieties of miscellaneous chemicals may have been understated.

SECTION I

WHITE PIGMENTS AND MINERALS

The consumption of white pigments and minerals in 1971 and 1972 by United States manufacturers of pulp and paper is presented in Table I-A. Data for 15 independent converters are given in Table I-B.

The totals for asbestos are heavily influenced by reports from a few manufacturers of building materials, and thus are not representative of usage by more conventional papermakers.

Total consumption of all grades of clay, including calcined, in 1971 was found to be 1,936,341 tons (excluding independent converters). This is about 11% less than the figure of 2,171,552 tons of clay for paper coating and filling reported for the same year by the United States Bureau of Mines. Approximately the same percentage difference existed between the totals reported by the two organizations in 1967, although the Institute's survey did not include either building materials or independent converters in that year. The Bureau of Mines is understood to obtain its data from producers of clays rather than from users, and does not provide a detailed breakdown by grades. Presumably reports from clay producers would include quantities that eventually reached independent converters as well as the few paper mills that are not represented in Table I-A; it is not known whether consumption by these plants would account for the 11 percent difference observed. Table I-B shows a 1971 total of 2,322 tons of clay used by the group of independent converters that responded, and this particular figure represented only 5 converting plants.

Zinc oxide pigment usage reported by papermakers was 5,925 tons in 1971 and 6,720 tons in 1972. Consumption by only a few independent converters (Table I-B) amounted to 35-40% of the figures submitted by paper producers.

TABLE I-A

CONSUMPTION OF WHITE PIGMENTS AND MINERALS IN THE UNITED STATES
BY PULP AND PAPER MANUFACTURERS

Pigment	Number of Reports: Increasing Usage	Number of Reports: Decreasing Usage	Number of Reports: No Change	Consumption[a] Short Tons, dry basis: 1971	1972	Rate of Change, %
Alumina, hydrated	21	11	18	22,910	22,340	-2
Asbestos		F[b]		96,535	90,675	-6
Bentonite	4	3	2	535	595	+11
Calcium carbonate						
Precipitated + by-product	32	11	12	96,995	107,400	+11
Natural (ground products)	9	7	8	17,000	14,665	-14
Calcium silicate		F		1,395	1,605	+15
Calcium sulfate		F		1,145	1,265	+10
Clay, coating grades						
Standard No. 1	28	18	11	174,090	187,755	+8
Standard No. 2	30	42	33	588,615	618,855	+5
Standard No. 3	8	0	1	54,870	58,875	+7
High brightness No. 1	23	8	12	127,400	128,290	+1
High brightness No. 2	7	4	7	41,411	44,010	+6
Delaminated, fine		F		29,770	34,390	+16
Delaminated, other	16	4	6	102,310	112,185	+10
Very fine, No. 1	6	1	4	17,440	26,440	+52
Very fine, No. 1 high brightness	10	4	1	69,070	78,840	+14
Clay, filling grades						
Premium brightness	12	3	8	67,800	70,330	+4
Water washed	55	52	38	461,510	441,425	-4
Air floated	37	19	8	192,970	221,190	+14
Clay, calcined grade	21	5	5	9,085	13,210	+45
Diatomaceous silica	15	9	10	5,255	5,845	+11
Silica, synthetic, pigmentary	14	19	15	25,975	27,075	+4
Silica, synthetic, other	9	7	9	1,920	1,610	-16
Sodium silico — aluminate	21	5	3	15,660	16,145	+3
Talc, for extender use (est.)	19	13	16	43,305	44,800	+4
Talc, for pitch control (est.)	31	21	15	20,695	23,125	+12
Titanium dioxide pigments						
Imported	14	11	8	25,475	25,570	0
Domestic anatase, coating	37	14	19	29,155	31,265	+7
Domestic anatase, filling	58	41	54	85,250	91,250	+7
Domestic rutile	26	14	9	16,175	18,260	+13
Other titanium pigments	14	6	5	5,435	6,295	+16
Zinc oxide	7	5	6	5,925	6,720	+13
Other white pigments[c]	9	7	5	3,635	3,745	+3

[a] Includes essentially all off-machine pigmented coating by basic papermakers, but data for other converted products, such as container board, boxes and packaging materials, were not reported by several major paper companies. Does not include data or estimates for independent converters, or for a few pulp- or papermakers listed in text.

[b] F = Fewer than 10 reports.

[c] In decreasing order: perlite, satin white, barium sulfate, miscellaneous clays, mica, unspecified.

TABLE I-B

CONSUMPTION OF WHITE PIGMENTS AND MINERALS IN THE UNITED STATES BY A GROUP OF INDEPENDENT CONVERTERS

Pigment	Number of Reports			Consumption[a] Short Tons, dry basis	
	Increasing Usage	Decreasing Usage	No Change	1971	1972
Alumina, hydrated		F[b]		2	1
Calcium carbonate					
Precipitated + by-product	2	1	1	81	147
Natural (ground products)	--	--	1	350	350
Clay, coating grades					
Standard No. 1	1	1	3	315	310
Standard No. 3		F		60	60
Very fine, No. 1 + high brightness		F		550	550
Clay, filling grades					
Water washed	1	1	1	1,395	1,405
Clay, calcined grade		F		2	2
Diatomaceous silica		F		2	5
Silica, synthetic, pigmentary		F		39	44
Silica, synthetic, other	4	1	1	103	138
Titanium dioxide pigments					
Domestic, anatase, coating	3	--	2	222	245
Domestic, rutile		F		351	309
Other titanium pigments		F		15	18
Zinc oxide		F		2,351	2,371
Other white pigments[c]		F		32	40

[a] Fifteen plants provided the information in Table I-B.

[b] F = Fewer than 5 reports.

[c] In decreasing order: barium sulfate, unspecified, mica.

SECTION II

LATEXES

Table II-A presents data on consumption of latexes by basic papermakers, and Table II-B by a group of independent converters. Latexes for pigment binder applications have been growing in use at an apparent overall rate greater than 10 percent per year since 1966. Growth of latexes for other purposes has been at an apparent annual rate of about 5% since the Institute's prior survey in 1963.

Polyvinyl acetate latex for pigment binder use has increased at the expense of acrylic latexes, while styrene/butadiene has maintained its share of the total. For other applications, SB and polyvinyl acetate latexes have markedly increased their percentage of the whole, while SBR, neoprene, and nitrile types have lost ground; the relative proportion of acrylic latex has increased somewhat.

Of the group of 19 independent converters that reported chemical consumption of some kind, 12 were consumers of latex (Table II-B), and the quantities are substantial. No attempt was made to estimate total usage of latex by converters.

TABLE II-A

CONSUMPTION OF LATEXES IN THE UNITED STATES
BY PULP AND PAPER MANUFACTURERS

Latex	Number of Reports: Increasing Usage	Number of Reports: Decreasing Usage	Number of Reports: No Change	Consumption[a]: Short Tons, dry basis: 1971	Consumption[a]: Short Tons, dry basis: 1972	Rate of Change, %
Pigment binder use						
Acrylic	11	5	6	3,860	4,525	+17
Polyvinyl acetate	26	13	23	19,215	23,215	+21
Styrene/butadiene, SB	45	21	27	61,680	65,880	+7
Other	3	2	0	435[b]	720[b]	+66
Saturating, etc.						
Acrylic	9	1	11	2,170	2,270	+5
Neoprene	6	1	5	3,065	3,000	-2
Nitrile	4	3	8	1,435	1,455	+1
Polyvinyl acetate	6	2	8	4,100	4,305	+5
Polyvinylidene chloride	4	3	2	1,160	1,110	-4
Styrene/butadiene, SB	9	2	2	13,195	11,780	-11
Styrene/butadiene, SBR	6	2	3	3,765	4,365	+16
Other	7	0	2	2,740[c]	2,895[c]	+6

[a] Includes essentially all off-machine pigmented coating by basic papermakers, but data for other converted products, such as packaging materials, were not reported by several major producers. Does not include data or estimates for independent converters, or for a few papermakers listed in text.

[b] In decreasing order: polyvinyl chloride and unspecified.

[c] In decreasing order: natural rubber, polyvinyl chloride and copolymers, unspecified.

TABLE II-B

CONSUMPTION OF LATEXES IN THE UNITED STATES
BY A GROUP OF INDEPENDENT CONVERTERS

Latex	Number of Reports: Increasing Usage	Number of Reports: Decreasing Usage	Number of Reports: No Change	Consumption[a] Short Tons, dry basis: 1971	Consumption[a] Short Tons, dry basis: 1972
Pigment binder use					
Acrylic	3	1	3	248	256
Polyvinyl acetate	5	1	1	310	306
Styrene/butadiene, SB	2	--	1	1,521[b]	1,528[b]
Saturating, etc.					
Acrylic	4	--	--	113	154
Polyvinyl acetate	1	1	--	80	80
Polyvinylidene chloride	1	--	--	6	27
Styrene/butadiene, SBR	--	--	1	6	6

[a] Twelve converters reported consumption of latexes.

[b] May include applications other than pigment binding.

SECTION III

PAPERMAKING ADDITIVES

Consumption data for sizing agents, wet-strength agents, dry-strength and formation agents, and retention, drainage and formation agents are recorded in Section III. Most of these additives have not been included in any previous Institute survey. Information pertaining to papermakers is presented in Table III-A, whereas Table III-B represents 3 independent converters out of a group of 19 that used chemicals.

It is important to note that an attempt has been made to convert all data in this section to a dry solids basis. This was difficult to accomplish in the case of the wet-strength additives and the synthetic polymer types of retention, drainage and flocculating agents, since reports often provided no clues as to the nature of the material.

A number of respondents reported cornstarch as a form of anionic starch. All companies that listed large consumption of anionic starch were asked to verify their reports, and corrections were made where necessary.

Several years ago, a limited study of cationic starch demonstrated that many previous consumers had changed to other additives. The present data indicate a reversal of this trend, and growth is now about 11 percent annually.

The Institute was asked to inquire whether the papermaking additives were introduced at the wet end of the machine or were applied in some other manner. Many reports did not respond to this inquiry, so the breakdown of the 1972 data presented in Table III-C is of limited significance.

TABLE III-A

CONSUMPTION OF PAPERMAKING ADDITIVES IN THE UNITED STATES
BY BASIC PAPER MANUFACTURERS

Additive	Number of Reports: Increasing Usage	Number of Reports: Decreasing Usage	Number of Reports: No Change	Consumption: Short Tons, dry basis: 1971	Consumption: Short Tons, dry basis: 1972	Rate of Change, %
Sizing agents						
Rosin-base, fortified, pale	89	53	73	100,215	100,660	+1
Rosin-base, fortified, dark	30	17	24	19,930	21,925	+10
Rosin-base, unfortified, pale	11	15	9	9,665	9,190	-5
Rosin-base, unfortified, dark	21	12	13	19,310	19,235	0
Wax and wax-rosin emulsion	54	32	49	8,535	8,820	+3
Asphalt emulsion	7	7	10	30,060[a]	30,330[a]	+1
Polyvinyl alcohol, uses other than pigment binder	23	13	33	4,420[b]	4,795[b]	+8
Other sizing agents	46	18	27	4,190	5,800	+38
Wet-strength agents						
Urea/formaldehyde	62	31	33	25,685[c]	26,360[c]	+3
Melamine/formaldehyde	39	21	29	7,225[c]	7,640[c]	+6
Other	48	27	38	7,845	8,360	+7
Dry-strength and formation agents	13	8	10	4,980	5,445	+9
Retention, drainage, and flocculating agents						
Synthetic polymers	63	23	54	4,925	5,345	+9
Anionic starch	11	5	10	3,720	4,050	+8
Cationic starch	65	21	34	40,420	45,575	+11

[a] Substantially estimated, with guidance from users.

[b] These quantities of polyvinyl alcohol are repeated in Table IV-A.

[c] Includes an approximation for captive production from stated quantities of raw materials.

TABLE III-B

CONSUMPTION OF PAPERMAKING ADDITIVES IN THE UNITED STATES BY A GROUP[a] OF INDEPENDENT CONVERTERS

Additive	Consumption, Short Tons, dry basis	
	1971	1972
Sizing agents		
Wax and wax-rosin emulsion	6	7
Other types, unspecified	30	23
Wet-strength agents		
Urea/formaldehyde	63	50
Melamine/formaldehyde	2	2
Other types, unspecified	3	3

[a]Three plants are represented, 1 or 2 for each additive.

TABLE III-C

CONSUMPTION OF PAPERMAKING ADDITIVES IN THE UNITED STATES
BY METHOD OF APPLICATION, 1972

	Consumption, short tons, dry basis			
	Wet End	Other Application	Not Specified	Total
Sizing agents				
Rosin-base, fortified, pale	61,120	180	39,360	100,660
Rosin-base, fortified, dark	13,510	--	8,415	21,925
Rosin-base, unfortified, pale	3,915	1,470	3,805	9,190
Rosin-base, unfortified, dark	12,795	--	6,440	19,235
(Rosin-base, total)	(91,340)	(1,650)	(58,020)	(151,010)
Wax and wax-rosin emulsion	4,035	1,255	3,530	8,820
Asphalt emulsion	2,530	70	27,730	30,330[a]
Other sizing agents	2,920	1,510	1,370	5,800
Wet-strength agents				
Urea/formaldehyde	10,815	7,585	7,960	26,360[b]
Melamine/formaldehyde	2,330	975	4,335	7,640[b]
Other	5,170	615	2,575	8,360
Dry-strength and formation agents	4,925	80	440	5,445
Retention, drainage and flocculating agents				
Synthetic polymers	2,175	455	2,715	5,345
Anionic starch	3,315	565	170	4,050
Cationic starch	15,625	3,255	26,695	45,575

[a] Substantially estimated, with guidance from users.

[b] Includes an approximation for captive production from stated quantities of raw materials.

SECTION IV

SELECTED MISCELLANEOUS CHEMICALS

Table IV-A presents 1971 and 1972 consumption data for pulp and paper manufacturers, and Table IV-B represents 14 independent converters from the group of 19 that reported use of one or more chemicals in the entire survey.

Note that all data have been converted to dry solids basis.

Some kraft pulp manufacturers that reported in mid-1972 may have overestimated salt cake usage for the year, and its use may actually have declined somewhat more than the 1 percent shown. A much more substantial decline is expected through 1975 at least, as kraft pulp mills improve operations and reduce sulfur losses for environmental reasons. Sodium-containing makeup chemicals may increase in use, as available, in order to maintain an appropriate balance of sodium and sulfur. Some 1972 estimates for caustic soda, sodium hydrosulfide and soda ash may also have been estimated improperly in mid-1972 by some respondents; future growth or decline of these chemicals may differ from the indications in Table IV-A.

TABLE IV-A

CONSUMPTION OF SELECTED MISCELLANEOUS CHEMICALS IN THE UNITED STATES BY PULP AND PAPER MANUFACTURERS

	Number of Reports			Consumption[a] Short Tons, dry basis		Rate of Change, %
	Increasing Usage	Decreasing Usage	No Change	1971	1972	
Casein	11	11	11	W[b]	8,065[c]	--
Soy protein	43	24	21	18,041	19,735	+9
Polyvinyl alcohol						
Pigment binder use	15	6	6	1,275	1,610	+26
Sizing and misc. use	23	13	33	4,420[d]	4,795[d]	+8
Sodium alginate	18	6	22	485	585	+21
Sodium carboxymethylcellulose (CMC)	17	13	16	770	825	+7
Caustic soda	122	57	99	1,424,000	1,533,600	+8
Chlorine	92	24	109	1,106,830	1,146,745	+4
Hypochlorite, calcium	9	6	12	345	335	0
Hypochlorite, sodium	14	6	12	35,750[e]	34,750[e]	-3
Hydrosulfide, sodium	12	0	4	W	53,915	--
Hydrosulfite, sodium	15	7	7	1,445	1,880	+30
Hydrosulfite, zinc	16	12	12	7,540	7,870	+4
Oxygen		F[f]		W	W	--
Peroxide, hydrogen	21	5	11	5,290	6,210	+17
Peroxide, sodium		F		800	455	-63
Salt cake	40	32	31	1,031,555	1,022,270	-1
Soda ash	69	35	84	224,180	206,090	-8
Sodium borohydride		F		W	W	--
Sodium chlorate	34	7	22	153,550	165,620	+8
Sodium silicate	32	21	38	42,730	44,110	+3
Sodium sulfite	29	13	18	165,190	170,950	+3
Sulfamic acid	15	5	18	1,940	2,095	+8
Sulfuric acid, 100% basis	90	24	61	666,005	697,780	+5
Sulfur dioxide, purchased as SO_2	32	14	15	76,740	79,445	+4
Zinc		F		W	W	--
Dyes and color pigments, total purchases	149	42	125	$52,968,000[g]	$56,325,000[g]	+6

[a] Includes essentially all off-machine pigmented coating by basic papermakers, but data for other converted products were not reported by several major companies. Does not include data or estimates for independent converters, or for a few pulp- or papermakers listed in text.

[b] W = Withheld.

[c] The casein total is substantially estimated. Of the data actually received, consumption in 1972 was 27% less than in 1971.

[d] These quantities of polyvinyl alcohol are repeated in Table III-A.

[e] Total is somewhat uncertain due to varied methods of reporting concentrations.

[f] F = Fewer than 10 reports.

[g] Approximately 27% estimated.

TABLE IV-B

CONSUMPTION OF SELECTED MISCELLANEOUS CHEMICALS IN THE UNITED STATES BY A GROUP OF INDEPENDENT CONVERTERS

	Number of Reports			Consumption[a] Short Tons, dry basis	
	Increasing Usage	Decreasing Usage	No Change	1971	1972
Casein	2	2	2	160	142
Soy protein	1	--	1	184	185
Polyvinyl alcohol, sizing and miscellaneous use	1	--	--	2	4
Sodium alginate	1	--	--	<1	<1
Sodium carboxymethylcellulose (CMC)	1	1	--	60	38
Caustic soda	--	1	1	68	43
Peroxide, hydrogen	--	1	--	1	1
Soda ash	1	--	1	41	41
Sodium sulfite	--	1	--	<1	0
Sulfuric acid, 100% basis	1	1	--	1,453	1,003
Dyes and color pigments, total purchases	6	--	4	$834,557	$965,000

[a]Fourteen plants provided the data in Table IV-B.

ACKNOWLEDGMENTS

The Institute wishes to express its sincere thanks to the personnel of the many pulp and paper manufacturers who have participated in these raw material surveys. Their continuing support in spite of adverse circumstances is greatly appreciated. We also wish to thank the small group of independent converters who responded to the questionnaire.

Institute staff members who offered valuable guidance in planning the study and in interpreting obscure references in replies included John W. Swanson, Carroll F. Garey and Joseph J. Becher. Sheryl A. Putnam, John O. Church, and the computer center staff effectively cooperated in handling the large quantities of data.

Appreciation is also expressed to the Institute's Editorial Department, and to the Secretarial and other service groups who were involved in the extensive mail survey.

THE INSTITUTE OF PAPER CHEMISTRY

W. S. McClenahan
Director
Division of Information Services